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GREAT SPIRAL STAR-CLOUD IN ANDROMEDA

250 Million-Billion Miles from End to End

New Worlds in the Making

By CLYDE FISHER

EVERYONE, after some observation of the heavenly bodies, begins to wonder at their origin. There is abundant evidence that the earth has not always been just as it is now. Even a superficial study of geology convinces one that the earth has a life story, if we can but read the record. And the more we examine the worlds outside of ours, the more we are persuaded that changes have been going on throughout the universe.

The first scientific theory of the origin of our solar system goes back to the philosophers Kant and Swedenborg. It was then developed and put into scientific form by La Place and became known as the Nebular Theory. According to this theory, the sun, all the planets and their satellites and the asteroids were once a huge, rotating, gaseous nebula, which extended out beyond the present orbit of Neptune. As this nebulous mass cooled, it contracted and its speed of rotation increased. This increase in the speed of rotation was accompanied by an increase in the centrifugal force by which a revolving body tends to fly from the center.

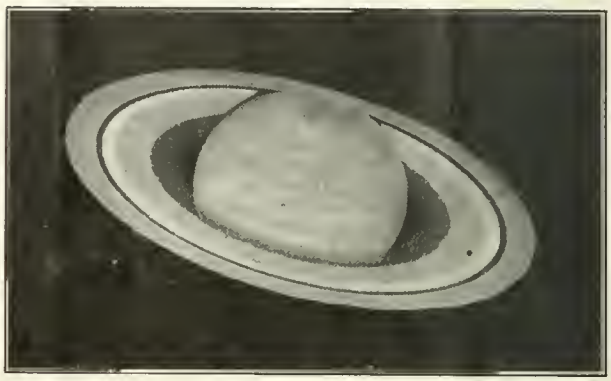
So it was with the outer part of this theoretical nebula. When this force had increased until it balanced the gravitational pull toward the center, the inner part of the nebulous mass contracted away from the outer rim. This rim was not thrown off like mud from a carriage-wheel, but was left balanced between gravity and its centrifugal force of rotation. This rim, which may not have been complete or even uniformly thick, was supposed to be collected together in a globular mass by the gravitational attraction of each particle for every other. Thus the outermost planet was first formed. In the same way the rest of the planets were successively formed, the one nearest the sun being the last formed. In the case of the asteroids, the tiny planets between the orbits of Jupiter and Mars, it was supposed that this rim gathered into more than a thousand small masses.

The moons or satellites of the planets were supposed to have been formed in the same way, after each planet mass had been left balanced between gravity and centrifugal force, and still revolving around the central portion of the original nebulous mass.

As the nebulous matter condensed and cooled, it changed from gas to liquid and then to solid, at least in the case of the four inner planets, Mercury, Venus, Earth and Mars. The four outer and larger planets, Jupiter, Saturn, Uranus and Neptune, still seem to present only an outer surface of cloud.

When the nebular theory was first conceived, it was thought to have two kinds of evidence in its favor, first, features in our solar system which the theory would account for, and second, systems outside our own now in phases suggesting the early stages of our own.

Evidence of the first kind was most impressive, for it was thought the theory would explain the following conditions: 1) The planetary and most asteroid orbits are nearly in the same plane; so as to occupy a narrow belt in the heavens; 2) These orbits are nearly circular; 3) All the planets and asteroids revolve around the sun in the same direction; 4) The sun also rotates in that direction and its equator is but little inclined to their orbits; 5) The satellites revolve about the planets in the same direction in orbits nearly circular and nearly in the plane of each planet's equator (except two satellites of Jupiter and one of Saturn); and 6) The planets of the greater density are nearer the sun. If these relations were due to chance, we would have expected to find the planets and asteroids scattered over the sky and revolving around the sun or each other in many diverse ways. The conditions as they are point to a common origin and an orderly development.



Planet Saturn and Its Rings once thought to illustrate stage in evolution of Solar System

The second kind of evidence, the phases in systems outside which suggest stages in the development of our own solar system, consisted largely of nebulae. No telescope is powerful enough to reveal planetary systems around any of the stars, even if they exist. The Great Nebula in Andromeda and that in the sword of Orion can be seen with the naked eye, and many more were discovered with the telescope. Sir William Herschel observed faint diffused nebulae, others in which a nucleus can just be discerned, and others in which the nucleus is a brilliant star-like point. And the spiral nebulae certainly appeared to be solar systems in the process of development. Larger telescope resolved some of the so-called nebulae into stars. At first this was thought to be fatal to the nebular theory, because of the natural conclusion that still larger telescopes might resolve the rest of the nebulae into stars. But the invention of the spectroscope proved that some nebulae were really gaseous and so re-established the nebular theory.

But in recent years, the nebular theory has lost ground. The spiral nebulae are now believed to be immense universes outside of our own galactic system. (*See front cover.*)

And present-day astronomers find two big difficulties. First "it can be proved that an extended tenuous ring would not condense into a single body, but into many bodies, like the asteroids or the rings of Saturn. Second, 98 per cent of the angular momentum of the solar system is at present associated with the orbital motions of the planets, comprising only 1/700th of its mass. The *total angular* momentum cannot be altered by any internal changes within the system, and no process has ever been imagined by which 98 per cent of it could have been segregated in less than 1/700th of its mass."

The nebular theory attempted to explain the origin of the solar system under the action of forces entirely within the system, but this is now believed by many astronomers to be impossible. The present distribution of angular momentum is believed to be due to forces from the outside of the system.

About twenty years ago Chamberlain and Moulton of the University of Chicago proposed an alternative theory which overcomes the difficulties. According to this theory, our sun in the remote past was a star without planets. Another such sun in journeying through space came so close to our sun as to cause a tremendous disturbance, pulling out great masses of the sun and starting them on their revolutions. By a kind of explosion, due to the disturbance of gravity, myriads of these masses were projected into space, the so-called planetesimals. Not only was this new theory free from the fatal difficulties of the nebular theory, but it explained many features of the solar system and pointed to a common origin by an orderly process.

The myriads of planetesimals left revolving around the sun were slowly gathered together by the action of gravity into planets, satellites and asteroids. Perhaps meteors and comets are stray planetesimals.

The craters on the moon, some believe, were of volcanic origin, but there is much to favor the theory that they were caused by the impact of planetesimals or meteorites.

Among recent modifications of the planetesimal theory should be mentioned the tidal theory of Jeans and Jeffreys who agree in the encounter between our sun and some other star, but differ as to the dynamic details.

The age of our solar system, since the great catastrophe which started its development, is estimated with great probability to be from five to ten billions of years.

The Origin of Man from the Anthropoid Stem

When and Where?

(From Bicentenary Number of American Philosophical Society's Proceedings, Vol. LXVI, 1927)

By WILLIAM K. GREGORY

IN his recent articles on the origin of man Professor Osborn rules the apes out of the line of ascent to man on the ground that they have ape brains and ape minds, that they have degenerate thumbs and limbs adapted for acrobatic life in the trees, that they walk on all fours and have grasping hind feet.

Anti-evolutionists of all schools are doubtless rejoicing in the fact that Professor Osborn has repudiated man's descent from apes and has brought forward with all the authority of his name some of the very points which they have long been stressing. But their exuberance will be dampened somewhat when they realize that Professor Osborn, like Professor Wood Jones, separates man from the apes only in order to derive him eventually from a *far lower* branch of the primate stock.

Out of all the confusing tangle of resemblances and differences between men and apes, opponents of Darwin's solution of the problem have regularly seized upon a few of the more evident differences, to which they have given wide publicity. But they have consistently ignored or depreciated the mass of positive marks of kinship visible in the very early embryonic stages of apes and men, as well as in adult anatomy and in profound physiological reactions.

This evidence as to man's kinship with the apes is always weakened by being cited in small quantities, since its logical value lies in its cumulative weight. The defender of the Darwinian view is truly at a disadvantage precisely because his evidence is too extensive to be fully exhibited to his opponents. On the other hand, some who oppose Darwin's derivation of man from the apes imagine that they have raised serious objections to it, if they can cite even a few characters wherein modern man and ape differ.

Obviously there are many differences between man and the modern apes. If it were not so, there would either be no apes or no men and the problem would not now be under discussion. The first vital question is, are the characters, many or few, that are common to men and apes, due to inheritance from a more remote common stock, or are they due to parallelism? If the latter, if it still be admitted that man belongs in the order Primates, to what group other than the great apes is he most nearly related, by what steps has he diverged from that group, in what part of the world may we search for his ancestors and how shall we recognize such ancestors when we find them?

These questions in turn are quite obviously tied up with the general problem of the classification and geographic distribution of the families and subfamilies of the tree-shrews, lemurs, South American monkeys, Old World monkeys, apes and men, both recent and fossil. Since 1910 I have published a series of carefully worked out analyses of these problems, in which the Darwinian view of man's origin has been steadily upheld. The opponents of this view have not met the issues discussed in these papers. They have not

attempted a direct refutation of my arguments; they have not shown wherein I erred either as to facts or principles. They have simply made a flank attack by citing admitted differences between men and apes.

In these papers the evidence has been presented for the following outline of the history of the primates. By Basal Eocene times the primates were already in process of differentiation from the tree-shrew stock, which all authorities now regard as structurally ancestral to the primates. By Lower Eocene times we distinguish in both Europe and North America a branch which culminated in the modern *Tarsius*.

The structure of the hind foot is definitely known in the representatives of the Eocene families, as well as in all known recent and fossil lemurs, South American monkeys, Old World monkeys and apes, the hind foot having a widely divergent great toe, with a flat nail. Thus all the known palaeontologic, zoölogic and embryologic evidence supports the conclusion that from their first appearance the Primates as an order were thoroughly arboreal and that the terrestrial habits of the baboons and of man are a later acquisition. The early human embryo also retains the marked divergence of the great toe and even the adult human big toe retains the broad flat nail of arboreal Primates.

None of the lower groups—lemurs, tarsioids, South American monkeys—approach man except in obviously parallel features. They all stand on a distinctly lower plane and differ in many trenchant characters which are discussed in the papers cited.

The Old World series makes its appearance in the Lower Oligocence of Egypt. The most primitive known form, *Parapithecus*, is structurally intermediate between the stem of the tarsioids on the one hand, and the whole Old World series on the other. Although only the lower jaw is known, this highly important form must have had the shortened face and the swollen braincase, and probably the large eyes, of the small insectivorous tarsioids. Side by side with it is the oldest of the true apes, the lower jaw of *Propliopithecus haeckeli*. This has the dental formula common to the Old World monkeys, apes and man, but its lower jaw is deepened like that of the fruit eating apes and its molars already foreshadow the *Dryopithecus* pattern of the apes and man. It was plainly akin to the gibbons but smaller and more primitive. The eminent anthropologist Sergi has selected *Propliopithecus* as an ideal ancestor of man, but there is reason to believe that the human stem did not split off so far down the line. The modern gibbons have become specialized in the extreme length of their limbs and in the sabrelike form of their upper canine teeth, but they retain the hip callouses and other primitive features that ally them both with the Old World monkeys and with the anthropoids. According to Sir Arthur Keith's illuminating researches, the modern gibbons have already effected the profound readjustments of the internal organs necessary for the upright posture habitually adopted by the gibbon; this ape is no longer an arboreal quadruped but an upright-moving ape; its internal organs are actually far nearer to man than to the lowest of primates.

In the Miocene and Pliocene of India and Europe there was a wide spreading of the ape group, known, it is true, chiefly from teeth and jaws, some of which approach modern types. All develop the "*Dryopithecus* pattern" of the molars, the remnants of which are so clearly seen in man.

In the lower primates the principal axis of weight passes through the third or middle digit of the hind foot; such animals run upon the branches like arboreal quadrupeds. In the anthropoids the main axis of weight is shifted toward the inner side of the foot, in adaptation to the grasping habit. In the secondarily ground-dwelling mountain *Gorilla* the heel is broadened, the whole foot pressed flat upon the ground, the toes relatively shorter and the great toe relatively larger. In the human embryo of the ninth week the whole foot recalls the ape condition and differs widely from the adult foot, which doubtless for more than a million years has become thoroughly adapted exclusively for walking on the ground.

Sir Ray Lankester, knowing well only the more arboreal foot of the lowland *Gorilla*, endeavored to cast doubt on the evidence afforded by the more terrestrial foot of the mountain *Gorilla*, and clings to the belief that the peculiar construction of the human foot still constitutes a bar to the derivation of man from the anthropoid stem. Professor Adolph Schulz, on the other hand, has shown that during the course of its growth the human great toe is at first distinctly more ape-like and partly turned toward the other toes, but that as development proceeds it becomes twisted on its long axis so as to face downward, and is also drawn in toward the other toes. To transform a gorilla-like foot into a human foot, the big toe must increase in length and rotate on its own axis so that its surface shall be applied to the ground instead of facing toward the other toes. Next it would be necessary to shorten still further the toe-bones and to narrow the whole foot; that is, to make all the toes parallel, and the whole foot must be made to face downward rather than inward. One might also say that in order to transform an early embryo foot into the adult foot a number of changes are necessary; to enumerate these would be to repeat, word for word, the points of transformation of the foot of a gorilla into that of man.

The very fact that the great toe is the dominant one is strong evidence for the view that the human foot has been derived from an ape with a grasping great toe, for no other known primates afford such a favorable starting point for the human condition. Moreover, the muscles of the human foot show convincing evidence of special relationship to the anthropoid foot, as well understood from the time of Huxley.

In view of all this and of the fact that man is tied by so many other bonds to an order which was thoroughly arboreal in its first stages, the burden of proof would seem to lie upon anyone who prefers to maintain that the construction of the human foot constitutes a serious obstacle to the derivation of man from a pre-ape stem.

(To be concluded in our next issue.)

FREDERIC AUGUSTUS LUCAS

Dr. Frederic A. Lucas, director of the American Museum of Natural History from 1911 to 1923 and since then its honorary director, died at his home in Flushing, Long Island, on February 9th at the age of 76. He was buried at Plymouth, Massachusetts, where he was born March 25th, 1852.

He specialized in zoology and was an outstanding authority on ancient animals. He held important scientific and administrative posts with the United States National Museum and the Brooklyn Institute of Arts and Science before assuming the directorship of the American Museum, and was a member of many learned societies.

Dr. Lucas was well known to the readers of EVOLUTION through his many popular articles on The Animals of the Past, which have been very widely appreciated. The editors are trying to secure the use of much other similar material which he had prepared before his death. To help carry on the work he did so well in his life of long usefullness is our idea of honoring this kindly gentleman of science who never found any trouble too great in helping to further the cause of popular knowledge.

Sea Serpents and Such

By FREDERIC A. LUCAS

LIKE the "Fossil man," the sea-serpent flourishes perennially in the newspapers and, although now mainly regarded as a joke, there have been attempts to place him on a foundation of firm fact. The most earnest M. Oudemans expressed his belief in a rare, huge seal-like creature whose occasional appearance in southern waters gave rise to the best authenticated reports of sea-serpents. It has been suggested that some animal believed to be extinct had really lived over to the present. The few waifs spared from ancient faunas and stranded on the shores of the present, such as the Australian Ceratodus and our common Gar Pike were used to sustain this theory. If fish of such ancient lineage are still so common, why may there not be a few Plesiosaurs or Mosasaurs somewhere in the ocean depths? We may, of course, "suppose" anything, but as no trace of these creatures has been found outside of their ancient strata, all probabilities oppose the theory. But had these creatures been spared, they might well have passed for sea-serpents, even though Zeuglodon, the most serpent-like in form, was not a reptile at all.

Zeuglodon, "the yoke tooth," named from the shape of its great cutting teeth, was a strange animal, with four feet of head, ten feet of body and forty feet of tail, with body vertebrae of moderate size, but with those of the tail fifteen to eighteen inches long, the longest known for the bulk of the creature and weighing in the fossil condition fifty to sixty pounds. The tail obviously wagged the dog. The animal was fifty to seventy feet long and not more than six or eight feet through the deepest part of the body; the head was small and pointed, the jaws well armed with grasping and cutting teeth, and just back of the head was a pair of short paddles like those of a fur seal. Its articulations point to great freedom of movement up and down. This may mean it was an active diver, descending to great depths to prey on squid, as the Sperm-Whale does today, and that it could rear a third of its great length out of water for a wide view of its surroundings. If size indicates power, the great fluked tail was capable of propelling the beast at twenty to thirty miles an hour, a speed needed for the small head to provide food for the great tail. Or it may be that the inability to do this was the reason why Zeuglodon became extinct. On the other hand, the huge tail may have served to store up fat to be drawn upon when food became scarce.

Zeuglodons were numerous in the old Gulf of Mexico and seas of southern Europe, for bones are found abundantly. But common though the bones may be, the stories of their use for making stone walls resolve themselves on close scrutiny into the occasional use of a big vertebra to support the corner of a cornerib.

Its scientific name is Basilosaurus cetoides, the whale-like king lizard, given it by the original describer, Dr. Harlan, who thought it to be a reptile. The rule of science is that the first name given an animal may not be changed, even by a zoological congress, so Zeuglodon must masquerade as a reptile for the rest of its paleontological life. Owen's name "Zeuglodon," though not scientific, is too good to waste, being easily remembered and readily pronounced.

Dr. Albert Koch, doing with Zeuglodon as, later on, he did with the Mastodon, combined the vertebrae of several into a monster 114 feet long! This he exhibited in Europe under the name "Hydrarchus," or water king, finally disposing of the composite creature to the Museum of Dresden, where it was promptly reduced to its proper dimensions. Its natural make-up is sufficiently composite without any aid from man, for the head and paddles are like those of a seal, the ribs like those of a manatee, and the shoulder blades precisely like those of a whale, while the vertebrae are different from those of any other animal. There were also tiny hind legs tucked away beneath the skin, but these were unknown until Mr. Charles Schuchert collected a series of specimens for the National Museum, from which the entire skeleton could be restored. Unlike ordinary fossil bones which break indifferently in any direction, those of Zeuglodon are built of concentric layers, like an onion, which tend to peel off during the preparation of a specimen.

As the wheels of time and change rolled slowly on, sharks again came uppermost, the warm Eocene and Miocene oceans fairly teeming with these sea-wolves. There were small sharks with slender teeth for catching little fishes, larger sharks with saw-like teeth for cutting slices out of larger fishes, and sharks that might have swallowed the biggest fish of today whole. We know these monsters mostly by their teeth, for their skeletons were soft cartilage, the absence of their remains being the reason these creatures are passed by while the adjectives huge, immense, enormous are lavished on Mosasaurs and Plesiosaurs that the great-toothed shark, Carcharodon megalodon, might well have eaten at a meal. For its gaping jaws with hundreds of gleaming teeth must have measured not less than six feet across.

Our great White Shark, the man-eater, attains a length of thirty feet, and a man just makes him a good lunch. One of his teeth is an inch and a quarter long, while a tooth of Megalodon is commonly three, often four or even five inches. This would indicate a shark 120 feet long, bigger than any whale, to whom a man would be just a mouthful to whet his sharkship's appetite. Certainly it was at least seventy-five to one-hundred feet long, quite large enough to make bathing in

Jaws of Giant Fossil Shark.

the Miocene ocean unpopular. Megalodon and a contemporary and closely related species that originated with him in Eocene times may have had something to do with the extinction of Zeuglodon. This second species has a little projection at the base of the cutting teeth, like an "ear" on a jar, so that it is named *auriculatus*, or eared. The edges of its teeth are also more saw-like and with its length of fifty or sixty feet and better armament, it must have been most formidable. The supply of teeth never ran short, for back of each tooth in use lay a reserve of six or seven smaller but growing teeth ready to replace each front tooth lost and, like a well-trained soldier, to keep the line unbroken.

Once fairly started, these huge sharks swarmed everywhere that the water was warm enough, for their teeth occur in Tertiary strata in many parts of the world, and the deep-sea dredges of the Challenger and Albatross brought them up by scores. And then they perished utterly. Why? We do not know. Did they devour everything throughout their habitat and fall to eating each other? We do not know. But perish they did, while the smaller white shark lives on, as if to prove that it is best not to overdo things and that victory is not in the long run always to the largest.

The Anthropoid Apes

By EDWARD GRIEG CLEMMER

This is the first of a series of four articles on The Ancestors of Modern Man by the same author. The next will be on The Earliest Men.

THE living anthropoid, or man-like, apes are four in number, the gorilla and chimpanzee of Africa, and the gibbon and orang of Asia. Their near relationship to man is proved beyond reasonable doubt by comparative anatomy.

The gibbon is generically the lowest. It usually stands about three feet tall and has the longest arms in proportion to the body in the family. The arms are so long that the hands reach the ground even when the gibbon stands erect. Its natural habitat being in the trees, it does not seem to know what to do with its arms when it is forced to walk on the ground. In such circumstances it may rest the palms of the hands downward on the ground or raise the arms above the head. But in the trees the gibbon uses his long arms to advantage, swinging and leaping twelve to fifteen feet in a single jump. His arms have undoubtedly been lengthened by this necessity of his environment.

The Orang-utang, found in the woods of Borneo and Sumatra, stands second in the anthropoid scale. Indeed, the name in Malay means "Man of the Woods." The orang is usually about four feet in height and very bulky, measuring in circumference two-thirds its height. The arms are very long, reaching a spread of seven feet in an adult male. It is not as adept at arboreal life as the gibbon, but climbs deliberately as if not really used to such hazards. Yet he is not a slow traveller, for he can make as much time in the tree tops as a man on the ground.

The chimpanzees are the most interesting of the apes. They are found in equatorial Africa and are much less arboreal in their habits than the orangs. When they walk on the ground they assist themselves by touching their knuckles, being unable to walk upright more than a few feet.

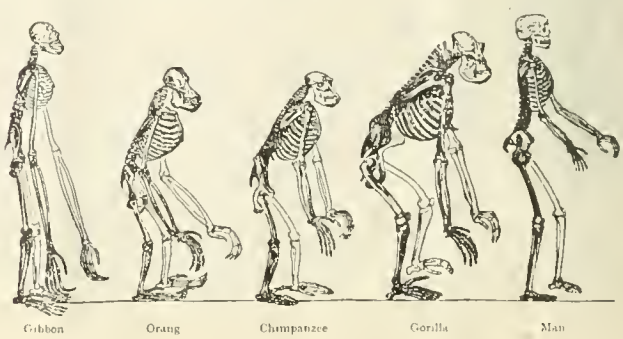
They are the most intelligent of the apes and can be taught to do many things a human being does. They can learn to eat in a civilized manner, dress in modern clothes, smoke and ride a bicycle. They take pride in their bag-full of tricks and have some capacity for performing original feats. The young are docile, but with puberty their temper changes and it is not safe to give them free rein thereafter. Many a young chimpanzee has delighted an audience with his mischievous and original performances.

In the minds of most people, the gorilla is the bizarre member of the family. This is on account of his great size and the tales of his ferocity and human ways of "trapping" his victims. Carl Akeley has, however, exploded many of the gorilla myths. He found him very peaceful if left to himself, but once aroused, a formidable enemy. An adult male stands about five feet seven inches when erect and weighs about three hundred and fifty pounds.

The gorilla is not tree-dwelling. It sleeps in nests on the ground, not elaborately built, but made of any twigs and leaves within easy reach. It usually travels in a family of eight or ten, consisting of three or more females, several offspring and from one to four males. It never walks upright, but on all fours, leaning the body forward with the knuckles touching the ground. We have little knowledge of its intelligence, as captured specimens rarely survive.

Practically all the anatomical changes which distinguish man from the apes are due to two causes; the forced change from the arboreal to the ground life, and the development of greater intelligence in man. When man's ancestors descended from the trees to the ground, they found it advantageous to develop an upright carriage. This made for stronger calf and hip muscles and changes in the big toe. The upright position also changed the position of the head on the spine, and the long ape arms, not being needed on the ground, were gradually shortened, if they were ever really developed in man's early ancestors.

In spite of some differences which may seem wide, the fundamental structures of the apes and man are closely similar. Moreover, modern blood tests indicate their kinship. There can be no reasonable doubt, in the face of the mass of scientific evidence and the unanimous conclusion of the scientific specialists, that man and the anthropoid apes are blood cousins.



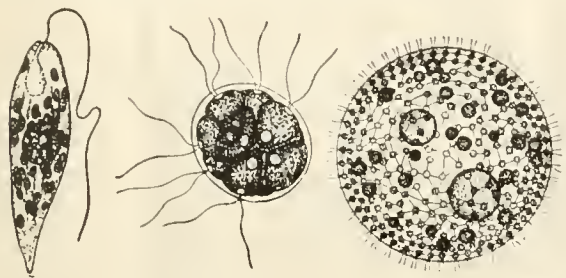
Plant Evolution

By FLORENCE DOWDEN WOOD

PLANTS have undergone as complete evolution as have the animals. There are three main lines of proof: 1) comparative study of existing plant forms; 2) specialization in reproduction; 3) fossil evidence. The lowest plants started out from a common stem with the single-celled animal. This single-celled organism, neither definitely plant nor animal, could not only digest food in the animal fashion, but could also manufacture its own food in plant fashion.

Any organism which can make food from the elements surrounding it, would seem ideal at first glance. Plants from the first, must have had this ability, but they have sacrificed the power of locomotion, as well as the possibilty for a central nervous system to guide them to adequate sources of food.

In plants, as in animals, the tendency has been to grow larger and larger, as much so as possible in each stage of evolution, given the then existing degree of specialization for food manufacture and reproduction. When size alone is considered, plants have been able to attain that without much in the way of specialization, as is seen in the enormous sea weeds, some attaining a length of 600 or more feet. An additional barrier, before attaining the goal of the modern seed plant, is the lack of a satisfactory means of reproduction, as all primitive plants require water in which the sex products can swim to each other. In no case is there a mechanical means provided for getting the sex cells together, except as the cells themselves have the power of motion. The higher plants depend on wind and insects for pollination.



1. Euglena, the plant-animal. 2. Pandorina, free swimming colony. 3. Volvox, a largr colony.

Assuming that we start with an undifferentiated "plant-animal" organism as the plant's great-grandmother, we must bring it up through the stages marked by the various levels of existing plants till we reach the highest type of seed plant. The first stage is *Euglena* (1). It is so small that a half dozen individuals can be put in the space of an "i" dot. The free-swimming plant-animal reproduces itself by simple division. In its eagerness to attain higher things, the new organism does not have time to separate completely from the old, resulting in a colonial form, the *Pandorina* (2) stage now barely visible to the naked eye. This colonial form has a tendency to grow larger. With further increase in size, there is too little economy of energy, and a new advance appears, a division of labor. Some cells are set aside for reproduction, while the rest manufacture food, and propel the organism about, as in the *Volvox* stage (3). The reproductive products, "eggs" and "sperm" in this stage are not essentially different in appearance from the original one-celled plant-animal.

Very soon this colonial form finds itself growing larger. It must then do one of two things, either remain small and free-swimming to avoid being broken apart by moving water, or to find a quiet place to sit down and grow. Having elected to lead a quiet life, the plant develops a set of "holdfasts," which resemble roots but do not function as such. These enable it to keep a firm grip on the rock or mud bottom of the water, as in the kelp or sea weed stage (4).

If the plant is to live on land, it must develop a system to get water, nitrates, inorganic salts, and CO_2 from its environment, and be able to collect them together for chemical rearrangement into foods. Also, it must develop a system of reproduction which does not require water to bring together its sex products to produce a new organism.

A big advance is made in the moss stage of our evolving plant. It has overcome some of the difficulties of food absorption. It has new absorptive root hairs on what we may call the old "holdfast"; food elements can be taken in from the soil, while the rest of the plant can emerge from the water. This moss plant has assumed a new form. It now has a distinct root, stem, and leaf, each of which has a special function. The root absorbs food, the stem distributes it, and the leaves manufacture starch from CO_2 and water, by the help of the sun's energy. Each of these structures is exceedingly primitive in its form and function, but they are the foundation of the large terrestrial plant of modern times. The mosses have a handicap, however; they can never get completely away from water. They are obliged to keep within range of moisture in order to liberate their free-swimming sex products.

The fern stage is a distinct step upward. It has a distinctly improved conductive system, real leaves, real stem, and a real root. Its reproduction system is modified. The asexual cycle has attained great proportions, as seen in the tree ferns, and the sexual cycle, though not less important, has been reduced to a tiny moisture loving plant, small enough to allow the male sex cells to swim to the female cells, which have lost their power to swim about and leave the plant that produced them since the early moss stage.

The problem of getting away from a method of reproduction which is dependent on water as a medium of dispersal for its sex products is extremely difficult. The solution is at least attained in the production of a seed. At first the seed is naked and extremely primitive (Gymnosperms—palms, ginkgos and pines). In a still more advanced stage the seeds are more evolved and well protected, (Angiosperms—hardwoods, shrubs and flowering plants). The flower which produces the seed, together with the seed, contain the key to the success of the modern plants. The plant which started as a very lowly, rather undecided organism, has now achieved the ability to live entirely on land. The sexual and asexual cycles have been neatly tucked away in the small compass of the flower and seed. This remarkable evolutionary achievement has allowed the plant to devote a great deal of energy to the formation of complicated independent conducting systems for both manufactured foods and for potential food elements and water.

The support of larger and larger structure has been taken care of in the formation of great bundles of framework whose function is to maintain the rigidity of the plant, holding it upright. The cells devoting themselves to this task are a magnificent engineering achievement.

"Sea Palm with Hold-fasts"

The most imposing of the modern seed plants to-day are certainly the big tree and the giant sequoia. But for the highest attainment in evolutionary complexity, as well as in numbers now populating the earth, we must look to the less spectacular sunflower group (asters, goldenrods, dandelions, etc.). Our original one-celled plant reaches the pinnacle of achievement in a beautiful chrysanthemum.

EVOLUTION

A Journal of Nature

To combat bigotry and superstition and develop the open mind by popularizing natural science

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NUMBER TWELVE

This issue of EVOLUTION is our Number Twelve. Thus we complete our "first year." It has been a hard battle, and it has taken more than a year to do it, but thanks to the support of its readers and writers EVOLUTION is "carrying on".

We doubt that any magazine has had contributions from more noted and gifted writers during its first year than EVOLUTION. During the coming year we expect to have articles from the leading authorities in every field of science.

And we are sure that no journal as young as ours has a more active and enthusiastic body of supporters among its readers. We now have over five thousand paid subscriptions, and the number is growing steadily. This is being achieved through the volunteer efforts of our readers and without working capital except as raised from month to month.

A reasonable period of this sort of work, and EVOLUTION will be on a self-sustaining basis. Then we can undertake larger campaigns of popular education.

This popular education must be multiplied an hundred fold to meet the coming need. Wherever defeated in the legislatures, the fundamentalists are sure to "appeal to the people" through referendum as they did in Arkansas. And the only way to prevent them from winning similar victories elsewhere is *popular education*. This is the reason for the existence of EVOLUTION.

NO FEBRUARY ISSUE

To get the advantage of predating we once more skip a month by name, although we do not skip a number. We expect to mail EVOLUTION the last week of each month for the following month.

THE TEST OF TRUTH

Let us not forget that back of this issue between Evolutionist and anti-Evolutionist is that greater issue between Scientist and Fundamentalist, "What is the test of truth?" Is it agreement of opinion with observed evidence, or with alleged authority?

Your scientist tests his theory by its agreement with the whole body of observed facts of experience and experiment. He alters no fact to suit his theory and holds no theory as true in the face of a single, stubborn, discrepant fact, be it well authenticated and verifiable. He submits his formulated opinion to the test of fact as a matter of course and asks you so to test it. He claims for it no sanctity, no privileges, no immunity from examination, criticism and attack. He welcomes each new significant fact acquired and each restatement of theory in closer agreement with all known facts. He searches for such truth eagerly, is overjoyed to discover it and to proclaim his discovery, but he does not ask that it bear his brand, nor that he and his opinions shall be given unquestioned authority. Nor does he ask that truth be pleasant, nor flattering, nor according to previous bias. To the extent that he may permit his wish and bias to modify his opinions, he does not represent the spirit of science.

With your fundamentalist it is otherwise. He prejudges the theory. His test of its truth is its agreement with the authority he happens to accept. He claims that that authority is divine and sacred from examination, criticism and doubt. Ask him to prove the divinity of his authority and he reiterates his belief that it is divine, questions your moral character for doubting him, charges you with sacrilege and threatens you with the dire consequences due the faithless. He asks you to accept his opinion because he himself accepts it. He makes his own belief, that is to say, himself, the authority. Differ from him and his alleged authority and you are wrong, intellectually and morally—and, of course, lost. Agree with him and you are right and saintly and saved.

He claims that evolution is untrue because he does not wish a "brutal ape" for ancestor, just as his medieval fundamentalist forbears denied that the earth travelled about the sun because they did not wish the habitation of MAN removed from its central importance in their universe. The inconvenient evidence of biologic, geologic and astronomic facts he denies or ignores. He does not want free inquiry and unbiased teaching and discussion. He wants his opinion protected by law from doubt and criticism, and confesses his lack of real faith in it by his refusal to let it stand or fall on its own merits. He makes himself the sole authority on truth and then wonders and berates because others will not take him at his own measure. A. S. B.

THE GREAT DEBATE

The Great Debate between Rev. W. B. Riley and Prof. Joseph McCabe on the question "Resolved that Evolution is True and Should be Taught in the Schools," held in New York February 7th, passed off without bloodshed.

The stenographic record of the festivities, complete and verbatim, will be published in EVOLUTION, beginning with the next issue. We shall not anticipate the arguments, except to assure our readers that a real treat is in store for them.

The audience was overwhelmingly in favor of McCabe. The vote was at least ten to one for evolution. This was to be expected, since the followers of Straton were most conspicuous by their absence, in the audience. However, they packed themselves in on the list of judges since inadvertantly the "gate had been left open," so to speak, and there they voted for Riley by 17 to 12.

The most interesting decision was rendered by a group of 41 High School students, who were also seated on the platform to pass their own opinion regarding the debate. They voted 35 to 6 in favor of McCabe.

The favor of these young people, the approval of Youth, means more to Professor McCabe and EVOLUTION than the anathemas of all the fundamentalist preachers.

Our own judgement of the arguments presented is that nothing better can be done for the cause of freedom of teaching than to circulate the arguments made by Rev. W. B. Riley exactly as delivered in comparison with those of Professor McCabe. So we'll print them in EVOLUTION and depend upon YOU to get your neighbors and friends to read them.

GETTING INTO ACTION

The Science League of America is girding its loins for battle with the fundamentalists in the legislative halls. The call to action is printed in another column. Every evolutionist should answer it. This work of the Science League is absolutely essential to winning freedom of research and teaching in all the states.

IMPORTANT TO HUMANITY

By Professor F. A. E. CREW.

"What is more important to humanity ... is the further extension and democratization of the evolutionary concept. It was this that overthrew medieval theology, and completed the enlarging of the mental horizon of humanity. Man's notion of himself has changed from that of a being originally created and awaiting a day of reckoning in a not too distant future, to that of a being originating as part of organic nature and set in a universe without beginning and without end. The intellectual revolution has emancipated countless men from the bondage of authority. It must free all.—From an article on "Biology and Education" in *Nature*, January 12, 1929.

Scientists Act for Freedom

University professors and co-operating research workers plan action against Fundamentalists.

By BARROW LYONS.

THE first steps have been taken by men of science toward combatting the influence of anti-evolutionists, who have virtually succeeded in eliminating the mention of evolution from the biology text books used in the elementary schools of the country. At the fiftieth annual meeting of the American Association of University Professors held in New York over the Christmas holidays action was taken authorizing the appointment of a special committee to co-operate with the American Ass'n for the Advancement of Science to fight anti-evolution legislation and other efforts to restrict the freedom of the teaching of science. Whether this effort will get far beyond the resolution stage remains to be seen.

Meanwhile the World's Christian Fundamentals Association continues to circulate its list of books considered safe for young Americans and to bring influence to bear upon text book commissions throughout the country in effectively preventing the publication of comprehensive biology text books. At least, enough commissions have rejected books mentioning evolution to influence publishers.

The appointment of the university professors' committee was authorized in a resolution strongly "deploring" all restrictions on the freedom of teaching scientific subjects. It urged the preparation of a circular to battle for the freedom of teaching and to point out clearly the "great harm" of all anti-evolution laws and regulations.

The American Association for the Advancement of Science also "took action" by passing as a committee of the whole a resolution which declared:

"We are convinced that any legislation attempting to limit the teaching of any widely accepted scientific doctrine is a profound mistake which cannot fail to retard the advancement of knowledge of human welfare. It is only by the maintenance of freedom of teaching that we can create conditions under which truth comes most rapidly to prevail. Therefore, we wish to make our most earnest protest against all legislation and administrative interference with the presentation of the facts and theories of science."

That is a good beginning, but it is not likely to be taken as a serious menace to the morals and welfare of American youth by the Fundamentalists. It does not breathe militant determination on the part of scientists.

There is no question, however, about the Fundamentalists forming a militant, fighting group. Small as the number of their leaders is, they have made matters sufficiently uncomfortable for those concerned with the production and distribution of text books. They are unusually dangerous gentlemen to tackle. They have caused the fall of more than one university professor, working quietly and under cover as often as by public ballyhoo.

Their strength lies in that they are moved by high moral endeavor, by the fervor which holds the glory of God above all else and leads them to heroic efforts to accomplish their ends. They believe themselves allied with the Deity and invincible. What school boards, what text book commissions, what publishers can stand before aroused righteousness of this sort?

And what have the school teachers of the country to offer against an onslaught of this nature? How can they bring the teaching of evolution back into the biology text books of the elementary schools? By what means can they make the judgment of science felt as against judgments colored by ancient superstitions?

That must be for teachers themselves to decide. I shall merely attempt to suggest some of the fundamental principles they must carefully think out, which must be generally agreed upon before there can be effective concerted action.

Thoughtful teachers for a long time have been asking who should be the authority as to what they should teach and where that authority should begin and end. On the one hand, it is evident that laymen unversed in science are incompetent to pass judgment upon fine points of scientific fact and theory. More and more the world relies upon the judgment of authorities and experts. But it is also evident that there must be some order and system in the curricula of public schools, where teachers are changing and pupils are being prepared for standardized courses of advanced education, the gateways to which are college entrance examinations.

Although requirements for secondary schools must be met in the elementary schools, and requirements for college must be met in the secondary schools, there is still considerable latitude for the teacher, if not interfered with by legislation or meddlesome school boards. Is it, then, sufficient to select the most competent teacher available and then leave it to him or her what to teach, or is the layman ever justified in prescribing details in the curriculum?

Another problem which teachers must face very seriously—and if they are not concerned there is no one else who will be—is that of the preparation of text books. As I pointed out in earlier articles of this series, some of the largest text book publishers admit that they print books for sale and not primarily for education or uplift. They are running large business; they are responsible to stockholders and must show profits. If they permit competitors to push them aside, they will show losses. Hence, they cannot afford to antagonise any considerable element of the community.

The principle is wrong. Text books should be printed for use and not for profit, for education and not to bring emolument to the shareholders of corporations.

It would be quite within the range of possibility for teachers to organize and operate a co-operative text book publishing house which would print science text books untainted by the influence of fundamentalism, history text books whose authors were free to tell the truth about the medieval church or the actions of our own forefathers which did not sidestep the rottenness in America, political science texts of American politics and economics, text books facing fearlessly the conflicts in contemporary productive organization.

The vitiation of science text books is merely the result of a thoroughly bad system which affects us in a thousand ways. It is through the perversion of the minds of young people, or at the best, keeping them in ignorance of a true picture of the world about them, that the system fastens itself most firmly upon the community.

Bigotry and intolerance flourish only where science is suppressed. Set free the teachers, put text books in their hands that tell the truth, and you have made a long step forward to a world rid of ancient superstitions and prejudices.

EVOLUTION ANNIVERSARY DINNER SATURDAY, APRIL THIRTEENTH

The charter of the EVOLUTION PUBLISHING CORPORATION is dated April 13, 1927. Last year this occasion was celebrated in New York and several other cities by Evolution dinners. This year we hope that Evolution dinners will be arranged in every city where EVOLUTION has readers, to celebrate the birthday of this champion of intellectual freedom and gather inspiration to carry to victory the struggle against fundamentalism.

Every reader with the necessary energy is invited to make arrangements in his community. Notify us of your intentions, and we'll wire you if some one has already started in your city.

Details, addresses where dinners will take place, hour and price, names of responsible managers, speakers etc. should reach us before March 20th for publication in April EVOLUTION.

All who arrange in time will receive message from New York dinner, and should send a message to be read at the dinner in New York. Let us make these simultaneous dinners a tremendous nation-wide demonstration in favor of The Open Mind.

Fundamentalism in England and America

By MAYNARD SHIPLEY

OUR British friends often take an attitude of pity and condescension toward us poor creatures harrowed by the inroads of Fundamentalist obscurantism. "How sad it is," they say in effect, "that science in America should have to contend with so out-dated a problem; and how fortunate are we in Great Britain that we have no such troubles here."

It would be fortunate, indeed, for English science if this assumption were correct. It is true, that there is far less open agitation against freedom of scientific teaching in their country and that that agitation comes from a group which has no standing culturally or politically. Also this struggle in which we are now engaged was fought and won three quarters of a century ago in England and even then it was a struggle between educated scientists and educated clergy; not, as here, between educated scientists and the fearfully uneducated clergy of the backward districts.

Nevertheless, the *World's* Christian Fundamentals Association was purposely so named. From its start in America, it is already carrying its campaign to Europe. George McCready Price, the Fundamentalist "geologist," spreading his gospel of the Noachic flood and the literal interpretation of Genesis, for several years has been head of a so-called college in England. Aimee Semple McPherson, in her recent evangelizing tour in England, did not neglect to attack the teaching of evolution. And other American Fundamentalist evangelists are pledged to carry on the work in every English-speaking country on the globe.

At this very minute, in Bootle, Lancashire, a city of 80,000, it is against the law to teach evolution in the tax-supported schools. London is not all of England, and much anti-scientific propaganda is being "put over" in the smaller provincial towns and vast districts of Wales, Ireland, and Scotland, where people still believe in witchcraft, as firmly as our "Pennsylvania Dutch" towns where no hint of modern scientific thought has so far penetrated.

Mr. F. Gosling, a prominent British Rationalist, remarked recently in a private letter, "There certainly is an optimistic side to your conflict. Over here it is all so hidden, and though some comfortable people point to the tremendous advances made, I feel that the present rate of progress in the real enlightenment of the masses is too slow. Said comfortable ones are likely to pity America with her Fundamentalists, but seem to be half blind to the unconfessed Fundamentalism so prevalent here.... It may be that in a few years' time we shall be wishing to goodness that our Fundamentalists here would be fools enough to come out into the open."

Another English writer agrees, "We, in this country, also have our Fundamentalists, and they exist, if we include Ireland and Wales, in an even higher proportion than yours. They are, moreover, of a more dangerous type than are yours. They 'sap' where yours make noisy, frontal attacks."

Plenty of people in America still shout "Alarmist!" to those who point out the ever growing danger to which fanaticism and ignorance are exposing the teaching of science. The same type of people take a similar attitude in England. But no one acquainted with that huge, semi-literate English sect the "Plymouth Brethren" and similar Fundamentalist groups can doubt that England also faces a real and increasing menace. England *seems* freer from anti-science threats not because she is really free, but because she is "next on the list."

In spite of the proud position of British science, and the real democracy and enlightenment of the better educated British thought, it may soon be necessary there, as it is vitally necessary here, to organize against the local manifestation of our common foe.

Activities of Science League

In November, for the first time in history, the initiative and referendum system was invoked, in Arkansas, to forbid the teaching of modern science. Nineteen other states have direct legislation, and the anti-evolutionists have announced that henceforth they intend to have recourse to this method whenever a legislature in one of these states proves "recalcitrant." Another phenomenon of 1928 was the appointment by the Florida State Senate of a committee of Fundamentalists to investigate and "purge" libraries of the State University and the State College for Women of scientific (particularly psychological) books not in accord with their theological views!

As we write, the 43 legislative sessions of 1929 are just opening. Already an anti-evolution bill has been introduced in the Texas legislature and killed by a close committee vote, only to be followed by another prohibiting teaching "contrary to the Book of Genesis." A bill to repeal the Tennessee law was promptly voted down, and a similar fate is anticipated for a like bill in Arkansas, though an anti-evolution enforcement bill there was indefinitely postponed. Dr. W. B. Riley has stated that he will again have an anti-evolution bill introduced in Minnesota, and definite threats of similar action come from New Mexico, Oklahoma, Colorado, Kansas and Montana. Before this report reaches you, several more states may well be facing anti-evolution legislation. Moreover, the "Defenders of the Faith," led by Paul Rader, have held a convention in Indianapolis, 100,000 strong, to arrange for anti-evolution activity in "48 nerve centers"—better known to us as the 48 secularly-governed states of the Union.

Educational and Defensive Work

Against this growing agitation, the Science League has continued its educational and defensive work to the limit of its resources. We have continued to act as a general information bureau for speakers, writers, and periodicals. In every state, up to and including Texas, where anti-evolution bills have been introduced, we have sent a strong protest brief, together with informative pamphlets, to the committee or the legislature, have asked our members in the states concerned to protest against the bills to their representatives, and have arranged for personal speakers against the bill if it should come to the floor. In Arkansas we worked through the local committee. We are now endeavoring, in case the repeal bill should be lost, to raise funds for a constitutional test of the Arkansas law, along lines which will not involve the martyrdom of a teacher. Incidentally, we have also been of help during the past year in securing new connections for several teachers who lost their positions because they taught evolution. Some of these cases occurred in states where no overt agitation has ever existed.

What You Can Do to Help

The demands upon us are increasing in far greater ratio than are the means at our disposal. The League is growing, but slowly; and the attacks on the teaching of modern science are growing much faster. Every member who is really heart and soul in this fight can be of great help to us if he will do one or more of the following: (1) tell his like-minded acquaintances about the League, and help us to build up the membership which alone provides our working funds; (2) keep his own dues paid up to date, and if possible become a life member (at the special rate of $20 instead of $25 extended to those already members); (3) send us names for circularization or distribute copies of our new leaflet, which will be printed in about a month; (4) send us prompt information and clippings relating to any new anti-evolution or similar activity in his own community; (5) contribute to the general or special work of the League; (6) help in the distribution of "The War on Modern Science," which tells the complete story of the anti-evolution crusade up to the summer of 1927, and has proved a startling eye-opener to many persons hitherto unaware of the situation.

Yours for freedom in research and teaching,

MAYNARD SHIPLEY, Pres.
Gillette Bldg., San Francisco.

The Amateur Scientist

A Monthly Feature *conducted by* Allan Strong Broms

The Constellation Orion

TO the south and right on the celestial equator you can easily identify the magnificent constellation Orion on these clear winter nights. It consists of an irregular quadrangle of four bright stars, marking the imaginary shoulders and legs of the mighty hunter of the Greek myths. From his belt (three stars in a row) hangs a glimmering sword of lesser stars. For his head there is a small triangle called Al Hakah, "the white spot," by the Arabs. In his right hand he wields an uplifted club and over his left arm carries a lion's hide for shield, both marked by groups of small stars.

The Constellation Orion

At opposite corners of the great quadrangle are two stars of the first magnitude, at the northeast, red Betelgeuse, "the armpit of the central one" in the Arabic, and at the southwest, diamond-blue Rigel. At the northwest corner is yellow Bellatrix, the Amazon star, of second magnitude, and at the southeast a third magnitude star, Saiph. The stars of the Belt (from north to south) are Mintaka, Alniham and Alnita, the first two white, the third yellowish.

Rigel, Mintaka and the brightest star of the head triangle appear double in the telescope, while Alnita is triple and the central star of the Sword quadruple. Even to the naked eye, this sword star has a strange shimmer. Viewed through an opera glass or small telescope, it is found to be surrounded by a faint nebula, the Greek name for cloud. Photographed with a large telescope and many hours exposure, this turns out to be one of the most beautiful objects in the heavens.

Mintaka and Betelgeuse are variable in their brightness. The latter is sometimes as bright as Rigel, at other times much inferior. Its variations are unpredictable, being quite irregular. Recent measurements at Mount Wilson Observatory with the great 100-inch telescope and by Michelson's new interferometer method indicate that Betelgeuse is nearly 250,000,000 miles in diameter or fifty million times the volume of our Sun. Its mass (weight), however, is only thirty-five times that of the Sun, for its density is very low, not much more than one-thousandth that of air. We would almost call that a vacuum. Its surface temperature turns out to be less than 3,000 degrees Centigrade, while that of the Sun is 6,000 degrees. While the Sun is white hot, Betelgeuse is merely red hot. Deep inside, however, the temperature undoubtedly rises to millions of degrees. It is probably a young sun just condensing from a nebula. As it grows older, its surface will turn white hot, its heat and even its substance will waste away and then, after billions of years, it will cool into a yellow star, then again red, and finally a dark star.

Rigel, with a diameter of 18,000,000 miles, over twenty times that of our Sun, and a surface temperature of 16,000 degrees, is at its evolutionary best. It would be about fifteen times as bright as Betelgeuse were it not three times as far away. The effect of distance on brightness is also well illustrated by a star to the southwest of Orion, the white Dog-Star Sirius, brightest of them all, as we see them. Actually, it is much inferior to Rigel and Betelgeuse in size and real brightness, but it quite outclasses them to us, because it is so very near, a mere matter of 50 million million miles.

YOUR BLIND SPOT

Try this experiment on yourself to find the blind spot in your eye. Close your right eye and read slowly with your left, being careful not to let it waver.

*—Watch the star disappear. If it does not, hold the page closer to your eye.

In the human eye the optic nerve enters the back of the eyeball, not in the center, but nearer the nose, so that in turning the left eye to the right at the proper angle, the image of the star falls on the spot where the optic nerve enters. As this spot is not sensitive to light, the star disappears.

The optic nerve, while capable of carrying nerve impulses that cause the sensation of light, is not itself sensitive to light. If it is injured, you do not feel pain, but get the sensation of flashes of light. If you feel pain at the same time, that is because another nerve carries other impulses to a pain-sensing center in the brain.

The optic nerve ends within the eye as a spread-out layer, called the retina. This retina covers nearly the whole rear of the eyeball and is sensitive to light. But like all the rest of us, it gets tired and dull from overwork. As we use its center most, we can sometimes see better by using a fresher portion. For instance, if you want a glimpse of the Orion Nebula described in the neighboring article, just look a bit askance (away from the nose) with either eye. If the night is clear and moonless, and your eyes are good, you may be rewarded with a faint, brief view. In this way you reverse the blind spot experiment.

BROMS TO LECTURE

Allan Strong Broms, our Science Editor, will deliver a course of five lectures on "EVOLUTION: From Star-Dust to Brain-Stuff" on consecutive Friday evenings, beginning March 8th at Union Auditorium, 229 West 48th Street, New York.

While these five lectures are intended primarily to interest the novice and enlighten the student, they will also be worthy of the science specialist because of the new material that will be presented. Readers need not hesitate to bring their most critical friends. The entire proceeds will be used for the promotion of EVOLUTION.

The subjects are announced on another page. Organizations in nearby cities that would like to arrange for this course of lectures should write for further details.

THE PROOFS OF EVOLUTION

The response to the question in our last issue "Shall we publish 'The Proofs of Evolution' by Henshaw Ward as a Pamphlet" was so encouraging that we printed it immediately and are ready now to fill orders. The quantity price is fifteen copies for a dollar, five dollars per hundred. One of our readers has already taken five hundred, and several have ordered a hundred each. This little gem by Henshaw Ward promises to become a "best seller."

From Our Readers

"The value of all things, EVEN OUR OWN LIFE AND TIME, depends on the use we make of it."—*A. Nielen.*

"I am called a modernist, but if there is anything that makes me inclined to become a fundamentalist it is your "EVOLUTION" Magazine. What corner of intelligence do you imagine you are cultivating? The cover of the January issue is typical of your mind. If you were really "scientific" you would not be crack-pated. Talk about "bigotry" of Arkansas. It is liberality de luxe compared with your narrowness." Elmer Wills Serl, Minister, The Church of Wide Fellowship, Southern Pines, N. C.

Premature Hosannahs

HOSANNAHS resounded in all the camps of the fundamentalists on the morning of January 21st when they read the Press dispatches from Washington, relating that Dr. A. H. Clark had renounced evolution and announced belief in the special creation of Man.

That these rejoicings were slightly premature is shown by the following comparison of reports:

First Report:

WASHINGTON, Jan. 20 (A.P.) Dr. Austin H. Clark, biologist, of the United States National Museum has propounded a new theory of evolution with revolutionary implications for biology and related sciences. He differs on vital points with the Darwinian theory of descent of man from a lower animal life and explains evolution as a series of jumps from one major form of life to another, rather than as a process of gradual development.

"So far as concerns the major groups of animals, the creationists seem to have the better of the argument," Dr. Clark said in announcing his theory. "There is not the slightest evidence that any one of the major groups arose from any other. Each is a special animal complex, related more or less closely to all the rest, and appearing, therefore, as a special and distinct creation."

The concept of Dr. Clark has man appearing on earth substantially as he is today, to all intents and purposes a product of special creation.

Dr. Clark sees no evidence of a "missing link," or intermediate form, between man and monkey.

Corrected Report:

(In New York *World*, February 3, 1929)

By DUDLEY NICHOLS

When scientific reports are constructed into news the results are only too frequently misconstructions, and that appears to have been the fate of the new theory of animal evolution proposed by Dr. Austin H. Clark a biologist of the Smithsonian Institute at Washington.

Perusal of Dr. Clark's thesis, now available in full in the Quarterly Review of Biology, indicates the error of the Fundamentalists in seizing the early news reports as weapons against the hated evolutionism. The very title of the biologist's paper is "Animal Evolution" and its aim is to propose an emendation, not denial, of man's concept of the evolution of present forms of life.

The paper may have been unfortunately worded, although it would never have been misunderstood by the biologists to whom it was addressed. Excerpts without the full text could be misused to stultify the whole report. The Associated Press dispatches from Washington, as printed in The World of Jan. 20, said, after quoting Dr. Clark:

"His concept differs with previous evidence of the descent of man from an apelike ancestor and asserts that man appeared on earth substantially as he is today— to all intents and purposes a product of special creation. His theory is that man appeared in practically the same form he has today because of an inherent capacity of life to produce a variant, or 'abnormality', having an enormously enlarged brain in an environment where it was able to survive."

Definition Lacking

The writer is unable to find the remotest resemblance to such statements in Dr. Clark's own words.

What the biologist did propose was that "the creationists" appear to have the better of the argument so far as the "major groups of animals" are concerned. A more specific statement of what he meant by major groups would have made the matter clear. The explanatory diagram which accompanied the paper provides the necessary meaning, though it is also sufficiently expressed in the amplified text, and shows that Dr. Clark was referring to enormously comprehensive divisions of the animal kingdom. For instance the most complex group is composed of the vertebrata, and that comprehensive division contains all those animals with a backbone or segmented spinal column, such as the mammals, birds, reptiles, amphibians, fishes, etc.

These major groups to which he referred, and upon which his new thesis was focused, are enormously inclusive. The substance of his idea affects these groups alone, and he maintains that when once life appeared on earth, in its protoplasmic form, there were certain internal and external forces which led it to develop simultaneously along four lines and produce—i. e. create—the prototypes in all these groups.

In short, says Dr. Clark in substance, here were the building blocks for evolution. It was not just one humble cell, the amoeba, endlessly branching up like a growing tree, until it should blossom at the top in man. Instead that humble form immediately set off on a four way cosmic track to produce the few great group-forms of life, and the tremendous animal kingdom as we know it could then evolve from these basic forms.

Threw Off Variants

The biologist suggests that this process of evolution may not be so gradual as heretofore supposed, and he cites in corroboration some of the remarkable variations which species and sub-species tend to produce. A changing environment and inner forces as well might combine to throw off a remarkable variant, which could exist more easily than its progenitors, and so would multiply and supersede the original type, thus giving the appearance of a small jump in the evolutionary process. But that a man suddenly appeared full-brained, as the news despatches told, is too preposterous even to contradict. The biologists to whom Dr. Clark was speaking will trouble themselves with no such chimera, but will question the data upon which he bases his theory that the prototypes of the few biological groups were products of a distinct creation. Even this last is but a thesis; that is, something laid down as a possible explanation of certain phenomena.

Before proceeding one might well inquire more closely into the meaning of these words, creationism and evolutionism. Philosophically, creationism is the doctrine that the world came into being out of nothing through an act of a transcendental Creator; that is a statement which science would not deny but only seek to interpret.

But commonly speaking creationism is the doctrine that distinct species of animals or plants were separately created, and Dr. Clark no more asserts that than he denies all science.

Limits Extension of Theory

His whole theory is focussed upon the creation of the major groups, and a species is, biologically speaking, but a small category of classification within a major group. A species is a category lower than a genus or sub-genus and above a sub-species or variety. All animals within a species may interbreed and reproduce.

While the idea of creationism is upheld by Dr. Clark for the major groups, he disposes of its extension by saying:

"But within each major group we see a very different picture. Here the fossil record shows a constant change from one horizon to another. These successive variations are probably simply indications of a direct response to physical alterations in environment favoring now one type or sub-type, now another.

"This continuous alteration in the elements within the various groups is what is commonly known as evolution. It is perhaps best illustrated by the vertebrates, since these are the most familiar of the animals.

"The evolution of the reptiles from the carboniferous to the end of the cretaceous, and of the mammals from the end of the basal Eocene to the present day, or rather to the Pleistocene period just past, forms a story of most absorbing interest. Here we can trace the gradual development from comparatively insignificant beginnings to a wonderful flowering of specialization and perfection. So much has been written on this subject, especially in recent years, that it seems unnecessary to pursue it further."

That sufficiently nails the notion of a specially and suddenly created man. As far as the layman is concerned, it does not alter in the slightest degree evolutionism as he is able to comprehend it. It leaves his evolutionary tree unaltered, except for some changes far down in the darker roots. There remains the imposing evolutionary tree of the vertebrates, with a minute ancient, worm-like creature at the bottom and the ten-fingered full-craniumed man at the top. What is new and important in Dr. Clark's paper can be intelligently weighed and discussed only by trained biologists.

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"THE BRAIN FROM APE TO MAN" by Frederick Tilney. Two volumes, 1120 pages. Paul B. Hoeber, Inc., New York. $25.00.

This pair of imposing volumes, furnished with a wealth of illustrations, might well serve as a valuable weapon, either physical or verbal, in an encounter with a fundamentalist. It fills several distinct gaps. The principal new contribution is a detailed, technical description of the external and internal anatomy of the brains of the following primates: lemur, tarsius, marmoset, South American monkey, baboon, old-world monkey, gibbon, orang, chimpanzee, gorilla, and man, with special emphasis on the brain stem. This part of the work will be a valuable source-book for any one working on human evolution or the neurology of primates, but it must be admitted that these details are dull reading for the specialist, and totally incomprehensible to anyone else. The effective summaries of behavior for each of these forms will be much more to the taste of the lay reader.

The chapter on the internal casts of the brain case of fossil men and submen furnishes a valuable summary and comparative interpretation of the available data. It seems unfortunate that "Australopithecus" (the fossil progressive ape-child of South Africa) is omitted from this study. There are two chapters of popular resumé — "From Primitive to Modern Man" and "Man —Past, Present and Future." The discussion of the elements involved in brain progress among the primates is interesting and suggestive.

It seems somewhat invidious to dwell on defects in a useful and valuable work, but it would be disingenious to deny their existence in this case. Various parts of the work vary in style from extremely popular to highly technical, and appeal to mutually exclusive audiences. Speculations as to the precise moment of the first appearance of the psyche will affect different readers in accordance with their own views on that topic. It seems an unnecessary bit of amateurishness to show comparative figures on discordant scales, without even a warning to that effect in the caption. Different meanings are given to the word "ape," some not in accord with general usage, and the reader is left to discover from the context in what sense the word is employed in each particular instance. Professor Tilney finds the brain of the gibbon more suggestive of the old-world monkeys than of the great apes, which is of considerable interest and importance; but it seems unfortunate on this account to call it an "intermediate primate," and "monkey," to the certain bewilderment of the general reader. It should be made clear that the assumption (by no means confined to Professor Tilney) that the great apes and possibly man also, have reached the end of their evolutionary possibilities, is purely an assumption, with no positive evidence whatever in its favor.

Tilney follows Osborn and others in suggesting that the complete absence of evidence of race mixture between the Cro-Magnons and the Neanderthals was due to high moral principles or else to something analogous to "drawing the color line." It is surprising that the obvious alternative explanation of physical sterility between two widely separated species seems never to have been offered.

If Professor Tilney could write as good a book as this it is perhaps regrettable that he did not write a still better one. In any case, the evidence that he marshalls furnishes still further evidence, if such be needed, of man's close resemblance to, and kinship with, the anthropoid apes, especially the chimpanzee and gorilla.

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It's bad enough to have an ape
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Much worse, for now we have a shrew
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But now the scientists with pep
Have taken still another step
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We place on our ancestral lists
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Not fit to serve upon a dish!

Then Doctor Stensio will trace
The fishes to an earlier race
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And next the scientist will find
The evolution of our kind
Goes back to arthropod or worm
That in the Cambrian slime would squirm.
Oh must this be, my learned friend?
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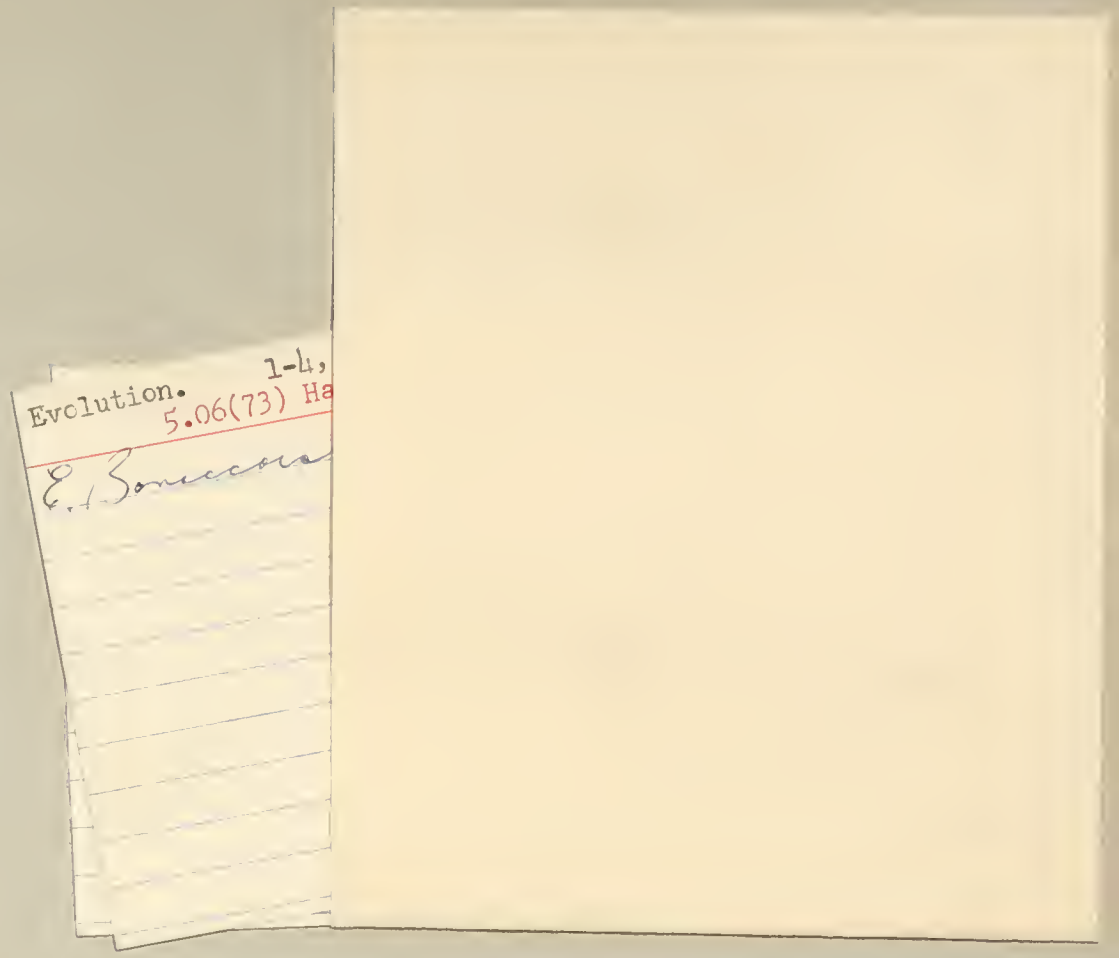

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